

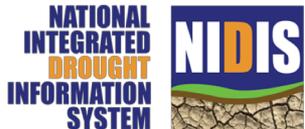
# Drought.gov GIS Efforts

Steve Ansari <sup>1</sup>, Kathryn Bevington <sup>2</sup>, Rocky Bilotta <sup>3</sup>, Alec Courtright <sup>3</sup>,  
Nancie McCraw <sup>3</sup>, Andrew Stowell <sup>3</sup>

<sup>1</sup> NOAA NCEI / NIDIS Drought.gov

<sup>2</sup> CIRES

<sup>3</sup> ERT, INC



**Drought.gov**



# GIS and Drought.gov

- Strategy
- Evolution
- Implementation

We are in the middle of this journey...

# GIS and Drought.gov

- GIS programming and infrastructure in support of Drought.gov website
- Support NIDIS partners and decision makers and general public
- Facilitates integration of data and information from a variety of drought information producers, a core Drought.gov mission
- Data management, visualizations, statistics
- Explore innovation, support NIDIS-funded research and transition to operations

# Strategy

- Our GIS strategy is evolving...
  - Simplicity
    - Less moving parts – simpler to implement and scale
  - Portability
    - Diverse solutions, right tool for the job
  - Support a better user experience
    - Faster, optimized maps
    - Usability testing
    - Improved accessibility and 508 compliance
  - Enablement
    - Easier to use and access drought data by non-GIS users

# Evolution: Data Management

- **Data >>> NCEI Database & NCEI ArcGIS Server >>> NCEI Map Services**

- Good integration with Desktop GIS users
- Web Services 😊 - but hard and/or expensive to scale and keep performant 😞
- More moving parts
- Difficult to integrate into our Linux data processing and automation
- Tools and services are harder for non-GIS users 😞

## ArcGIS REST Services Directory

[Home](#) > [services](#) > [nidis](#)

[JSON](#) | [SOAP](#)

**Folder: nidis**

# Evolution: Data Management

- Data >>> NCEI Database & NCEI ArcGIS Server >>> NCEI Map Services  
+
- Data >>> **Conda** (GDAL/TopoJSON/MapShaper)  
>>> Optimized GeoJSON/TopoJSON files,  
Raster/Vector tiles on file system (portable, cloud-ready)
- Data >>> **ArcGIS Online** >>> StoryMaps, OpsDashboard, Cloud GIS Services

# Evolution: Data Management

- Data >>> **Conda** (GDAL/TopoJSON/MapShaper/RasterIO)
  - >>> Optimized GeoJSON/TopoJSON files,  
Raster/Vector tiles on file system (portable, cloud-ready)
  - *Easy to automate*
  - *Portable, easily replicate for dev, testing and production*
  - *Cloud-ready for serverless processing*
  - *Fits easily into existing Linux workflows (but cross-platform to Win. & Mac)*
  - *Large, diverse selection of tools available, compatible with scientific packages in python, R. Emerging compatibility with ESRI*
  - *Great performance*

# Evolution: Data Management

- Data >>> **Conda** (GDAL/TopoJSON/MapShaper/RasterIO)
  - >>> Optimized GeoJSON/TopoJSON files,  
Raster/Vector tiles on file system (portable, cloud-ready)

```
> conda create -name my-test-environment
> source activate my-test-environment
> conda install -c conda-forge nco
> which ncks
~/anaconda3/envs/my-test-environment/bin/ncks
```

# Evolution: Data Management

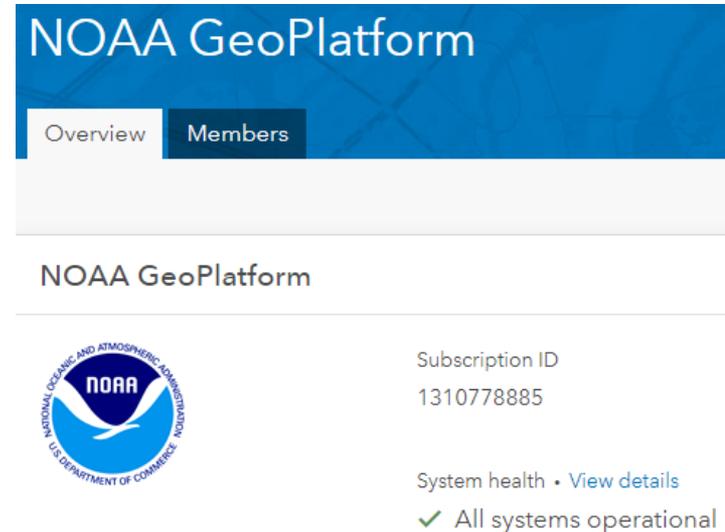
- Data >>> **Conda** (GDAL/TopoJSON/MapShaper/RasterIO)
  - >>> Optimized GeoJSON/TopoJSON files,  
Raster/Vector tiles on file system (portable, cloud-ready)
  - GeoJSON and TopoJSON formats: vector formats compatible with a large selection of web mapping libraries.
  - Highly compress and optimize data: reduce unneeded vertices, use appropriate precision, remove spaces, enabled server compression

# Evolution: Data Management

- Data >>> Conda (GDAL/TopoJSON/MapShaper/RasterIO)
  - >>> Optimized GeoJSON/TopoJSON files,  
Raster/Vector tiles on file system (portable, cloud-ready)
  - Original Shapefile: 1.3 MB compressed
  - Original GeoJSON: 2.2 MB
  - Simplified GeoJSON: 1.6 MB
  - Simplified TopoJSON: 589 KB
  - Compressed, simplified TopoJSON: 151 KB
- All data available from:  
<https://www.drought.gov/drought/drought-data-download-and-services>

# Evolution: Data Management

- Data >>> ArcGIS Online >>> StoryMaps, OpsDashboard, Cloud GIS Services
  - *Part of NOAA GeoPlatform (enterprise licensing with ESRI)*
  - *Rapid prototyping and development*
  - *Hosted data and content*
  - *StoryMaps: rapidly gaining popularity within NOAA*
  - *OpsDashboard:*
  - *Cloud hosting for layers*
  - *Working on automation*



The screenshot shows the NOAA GeoPlatform website. At the top, there is a blue header with the text "NOAA GeoPlatform" in white. Below the header, there are two navigation tabs: "Overview" and "Members". The "Members" tab is currently selected. Below the navigation tabs, the text "NOAA GeoPlatform" is repeated. On the left side, there is the NOAA logo, which is a circular emblem with the text "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION" and "U.S. DEPARTMENT OF COMMERCE" around the perimeter, and "NOAA" in the center. On the right side, there is a section for "Subscription ID" with the value "1310778885". Below this, there is a section for "System health" with a link to "View details" and a green checkmark followed by the text "All systems operational".

# Evolution: Presentation

- From: Many layers and standalone tools
- To:
  - Curated collection, in context, supporting content of drought.gov web content
  - Iterative usability testing throughout development, not after
  - Consistency between mapping applications and main website
  - Integrated tools and maps in main website (Drupal CMS) – not a separate tool
  - Use projections for U.S. and Global Data
  - Eliminate need to transfer an image (or tiles) when zooming in and out
  - Emphasis on accessibility as part of usability. (not *just* 508 compliance)

# Evolution: Presentation

U.S. North America Global



- Home
- Data, Maps & Tools
- Regions
- Research
- Resources
- What is NIDIS?
- News
- Calendar
- Contact Us
- Subscribe

## Advancing Drought Science and Preparedness across the Nation

### How is Drought Affecting your Neighborhood?

Enter your city or zip code for current conditions

Get Conditions

Where is drought this week?

October 10-16, 2018

20.5%  
of the US land area.

46.1 million  
people are experiencing drought.



View Upcoming Events & Webinars

Tweets by @DroughtGov



Did you miss today's Pacific Northwest [#webinar](#) - [#Drought](#) & [#Wildfire](#) Smoke Cause Challenges for Pacific NW? The recording is now online: <https://t.co/KGNxfSPWw> <https://t.co/v00lwcjgYL>



October 22, 2018



Dan McEvoy  
@hydromet\_man

Retweeted by NIDIS

We (@Shraddhanand) now have Evaporative Demand Drought Index (EDDI) and reference ET prob. seasonal forecasts available! These EXPERIMENTAL forecasts will be updated on the first of each month using CFSv2. [ftp://pubfiles.dri.edu/pub/mcevoy/cfsv2\\_eddi/](ftp://pubfiles.dri.edu/pub/mcevoy/cfsv2_eddi/) <https://t.co/bUBOrh3xQu>

# Evolution: Presentation

## Advancing Drought Science and Preparedness across the Nation

How is Drought Affecting your Neighborhood?

Reset



Severe

Current Conditions for Santa Barbara, California (Santa Barbara County)

Precip Total - Last 7 days | 0 in.

Average High Temp - Last 7 days | 86.86 °F

Report your drought impacts

California Conditions

Where is drought  
every week?

20.5%

46.1 million

# Evolution: Presentation



## Current Drought Monitor

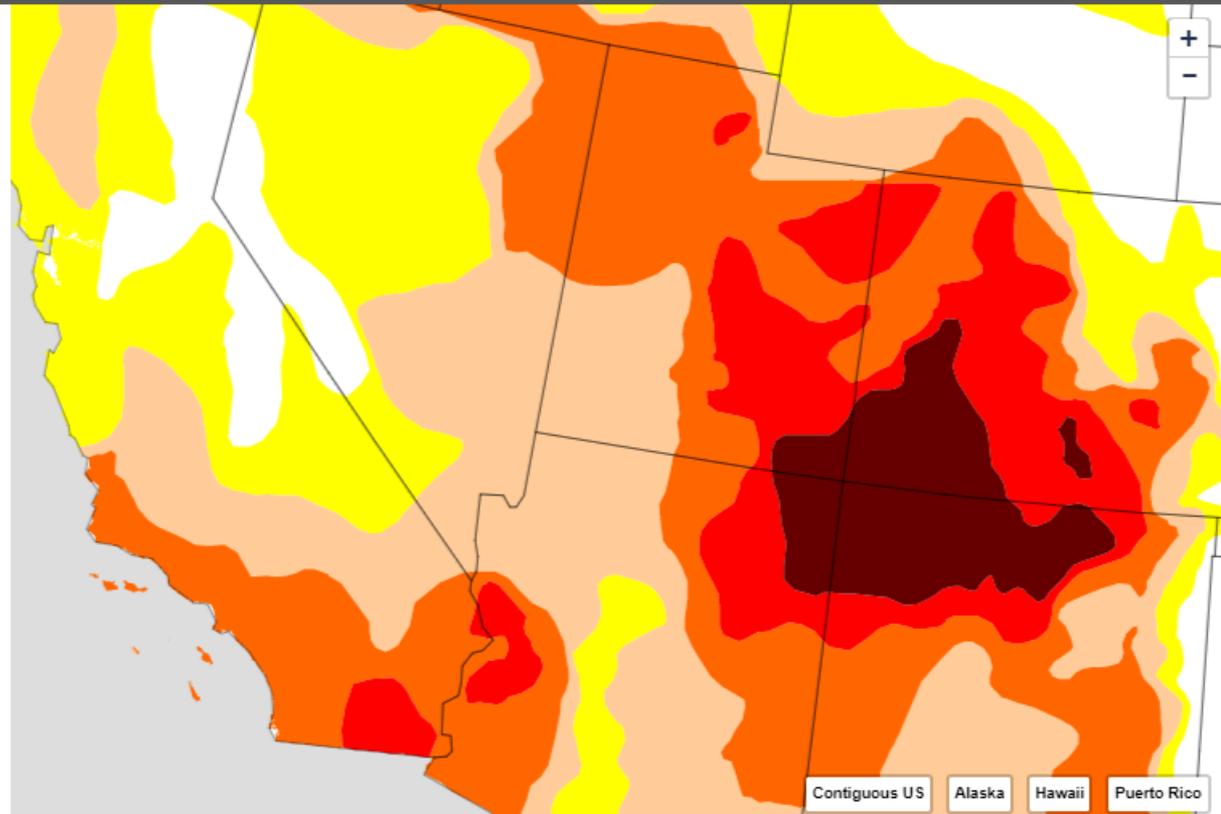
The U.S. Drought Monitor (USDM) is a map that shows the location and intensity of drought across the country. The data is updated each Tuesday and released on Thursday. This map shows the drought conditions on October 16, 2018.

Learn more about the US Drought Monitor

	<b>D0 - Abnormally Dry</b> <ul style="list-style-type: none"><li>Short-term dryness slowing planting, growth of crops</li><li>Some lingering water deficits</li><li>Pastures or crops not fully recovered</li></ul>	12.5% of U.S.	32.9% D0-D4
	<b>D1 - Moderate Drought</b> <ul style="list-style-type: none"><li>Some damage to crops, pastures</li><li>Some water shortages developing</li><li>Voluntary water-use restrictions requested</li></ul>	8.8% of U.S.	20.4% D1-D4
	<b>D2 - Severe Drought</b> <ul style="list-style-type: none"><li>Crop or pasture loss likely</li><li>Water shortages common</li><li>Water restrictions imposed</li></ul>	7.5% of U.S.	11.6% D2-D4
	<b>D3 - Extreme Drought</b> <ul style="list-style-type: none"><li>Major crop/pasture losses</li><li>Widespread water shortages or restrictions</li></ul>	3% of U.S.	4.1% D3-D4
	<b>D4 - Exceptional Drought</b> <ul style="list-style-type: none"><li>Exceptional and widespread crop/pasture losses</li><li>Shortages of water creating water emergencies</li></ul>		1.1% of U.S.

## October Drought Outlook

## Drought Outlook through January



# Evolution: Presentation

## Current Drought Monitor

The drought outlook through January 2019.

The Climate Prediction Center's (CPC) Seasonal Drought Outlook is issued monthly on the third Thursday of each month. The outlook predicts whether drought will emerge, stay the same or get better in the next three months, based on the U.S. Drought Monitor conditions when the outlook was released on October 18, 2018.

Learn more about the US Seasonal Drought Outlook

### Drought persists

Drought present on October 18, 2018 is expected to continue through January 2019.

11.2%  
of U.S.

### Drought remains but improves

Drought present on October 18, 2018 is expected to continue, but improve through January 2019.

5.5%  
of U.S.

### Drought removal likely

Drought present on October 18, 2018 is expected to be removed from the map by the end of January 2019.

4.1%  
of U.S.

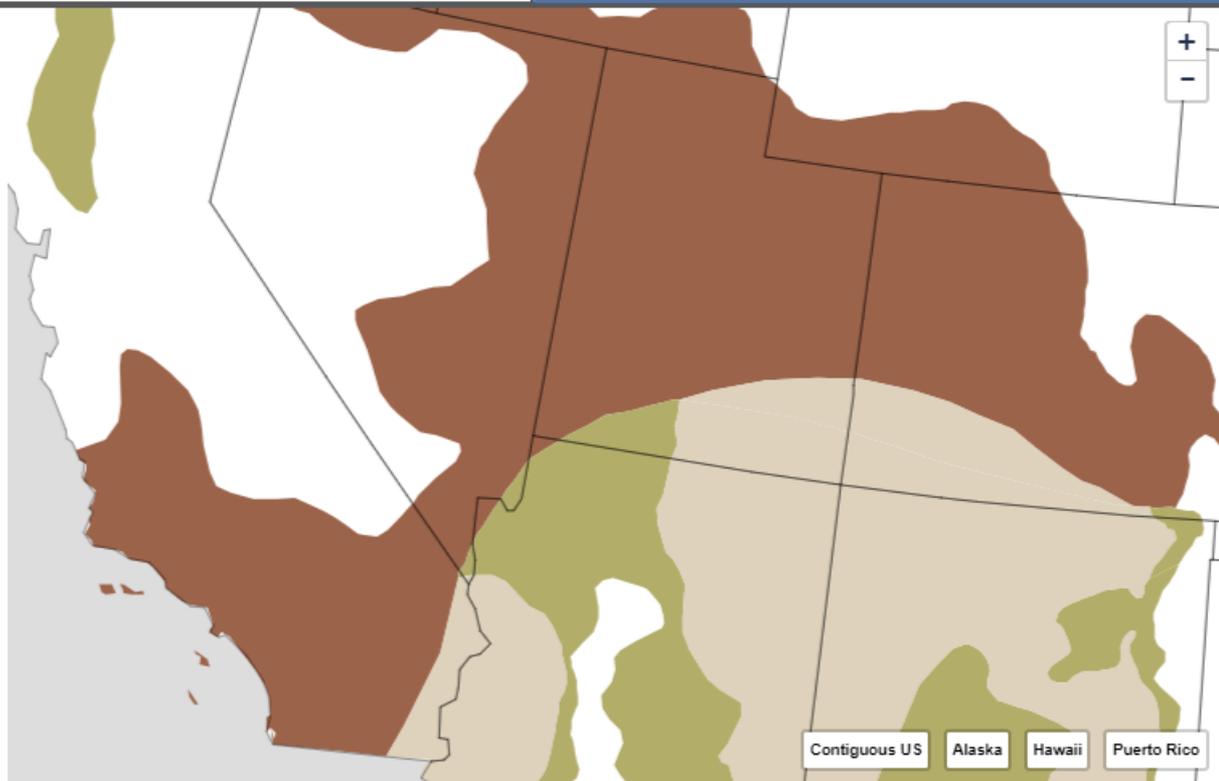
### Drought development likely

Abnormally dry conditions on October 18, 2018 are expected to intensify by the end of January 2019.

Error  
of U.S.

## October Drought Outlook

## Drought Outlook through January



# Evolution: Presentation

## Drought in California

Residents in drought:  
**23,463,000**  
10,769,000 more in abnormally dry areas.

This is:  
**63%**  
of the state's population,  
29% more in abnormally dry areas.



Report Your Drought Impacts

Last Month

Last Week

Current

Enter a city or zip code to add lo



Add to Map

Clear All

Highlight Counties that Produce:

Select None



The U.S. Drought Monitor (USDM) is a map that shows the location and intensity of drought across the country. The data is updated each Tuesday and released on Thursday. This map shows the drought conditions on October 16, 2018.

Learn more about the US Drought Monitor



### D0 - Abnormally Dry

- Short-term dryness slowing planting, growth of crops
- Some lingering water deficits
- Pastures or crops not fully recovered

**36.9%** of State  
**84.8%** D0-D4



### D1 - Moderate Drought

- Some damage to crops, pastures
- Some water shortages developing
- Voluntary water-use restrictions requested

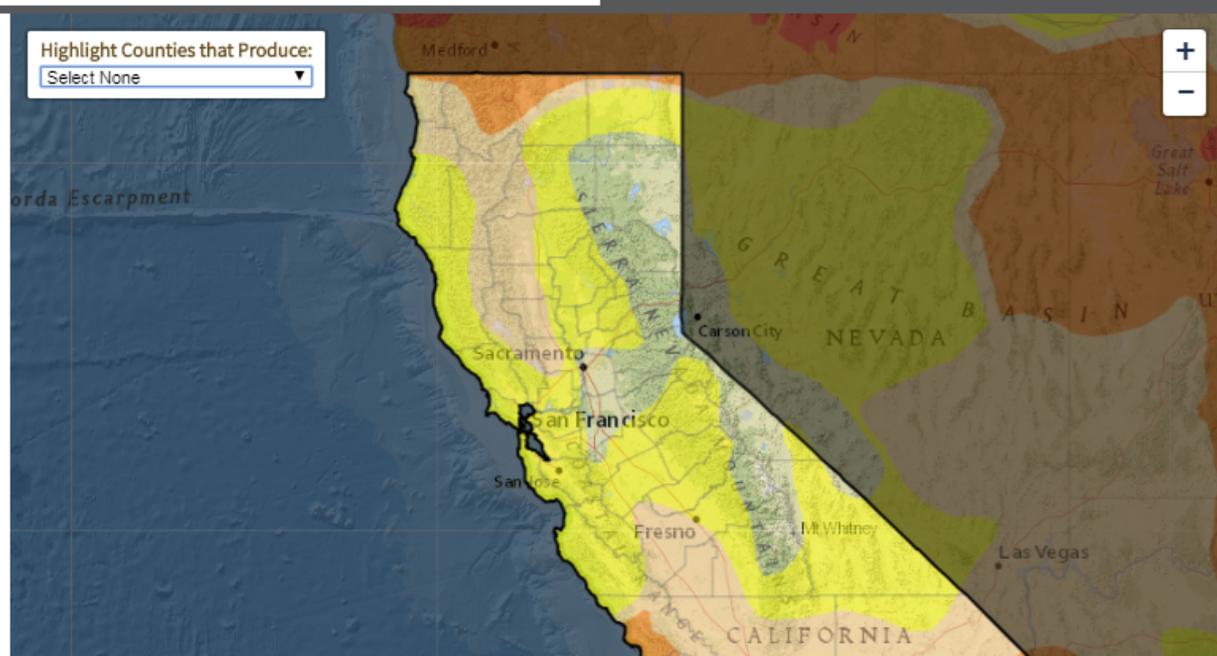
**25.1%** of State  
**47.9%** D1-D4



### D2 - Severe Drought

- Crop or pasture loss likely

**19.9%** of State  
**22.8%** D2-D4



# Evolution: Presentation

## Drought in California

Residents in drought:  
**23,463,000**  
10,769,000 more in abnormally dry areas.

This is:  
**63%**  
of the state's population,  
29% more in abnormally dry areas.



Report Your Drought Impacts

Last Month

Last Week

Current

Enter a city or zip code t



Add to Map Clear All

Highlight Counties that Produce:

Rice

The U.S. Drought Monitor (USDM) is a map that shows the location and intensity of drought across the country. The data is updated each Tuesday and released on Thursday. This map shows the drought conditions on October 16, 2018.

Learn more about the US Drought Monitor



### D0 - Abnormally Dry

- Short-term dryness slowing planting, growth of crops
- Some lingering water deficits
- Pastures or crops not fully recovered

36.9% 84.8%  
of State D0-D4



### D1 - Moderate Drought

- Some damage to crops, pastures
- Some water shortages developing
- Voluntary water-use restrictions requested

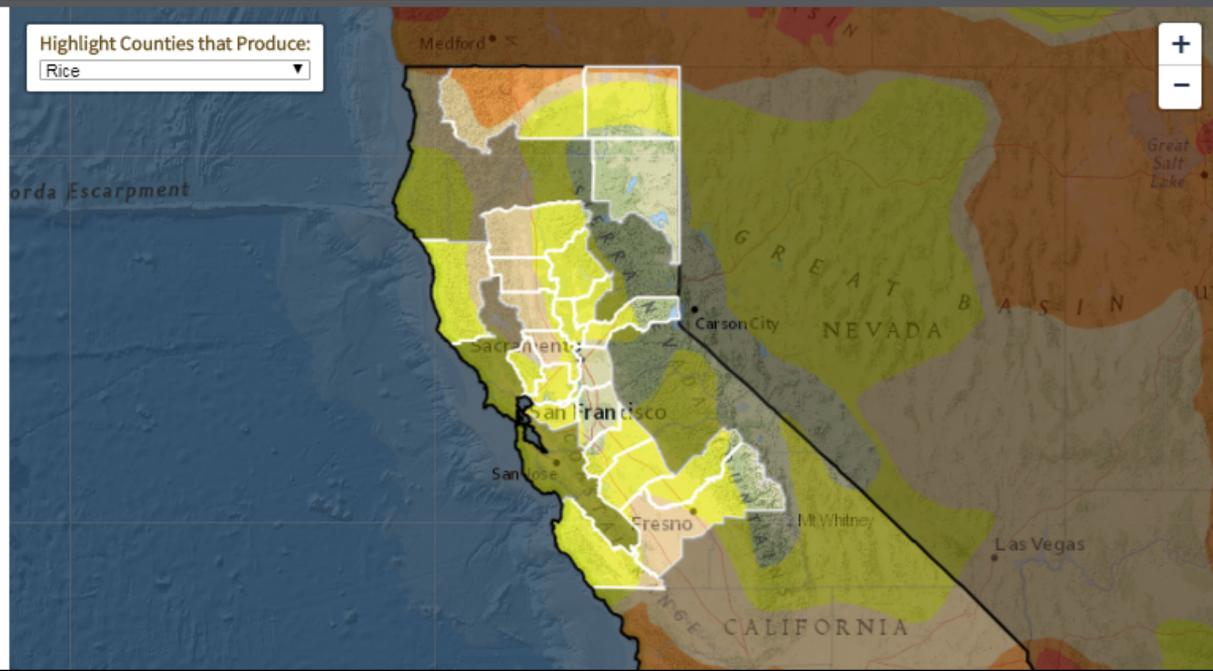
25.1% 47.9%  
of State D1-D4



### D2 - Severe Drought

- Crop or pasture loss likely

19.9% 22.8%



# Evolution: Presentation

Santa Barbara, CA, USA



Add to Map

Clear All

The U.S. Drought Monitor (USDM) is a map that shows the location and intensity of drought across the country. The data is updated each Tuesday and released on Thursday. This map shows the drought conditions on October 16, 2018.

Learn more about the US Drought Monitor



## D0 - Abnormally Dry

- Short-term dryness slowing planting, growth of crops
- Some lingering water deficits
- Pastures or crops not fully recovered

36.9%  
of State

84.8%  
D0-D4



## D1 - Moderate Drought

- Some damage to crops, pastures
- Some water shortages developing
- Voluntary water-use restrictions requested

25.1%  
of State

47.9%  
D1-D4



## D2 - Severe Drought

- Crop or pasture loss likely
- Water shortages common
- Water restrictions imposed

19.9%  
of State

22.8%  
D2-D4

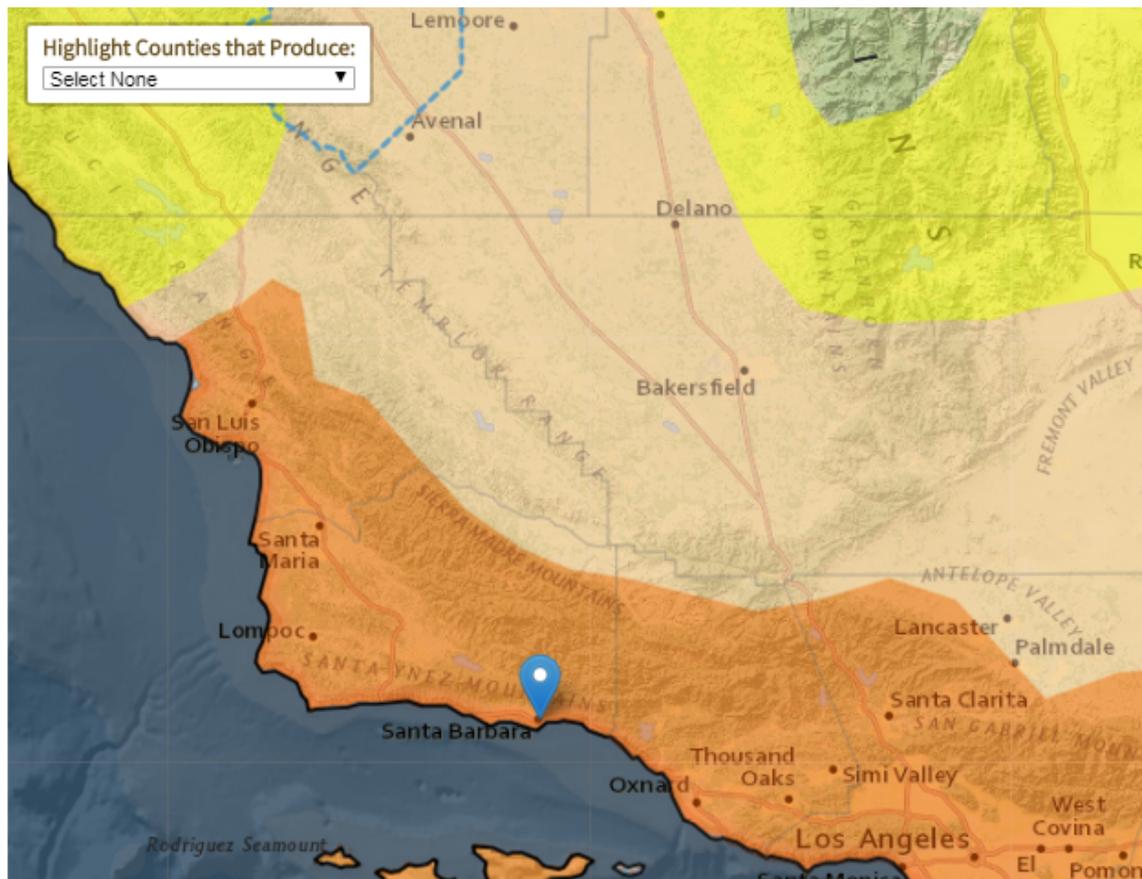


## D3 - Extreme Drought

- Major crop/pasture losses

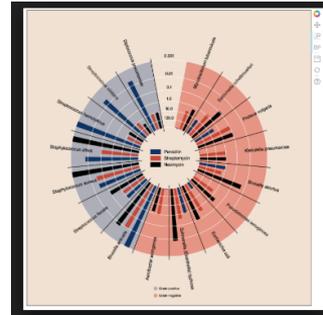
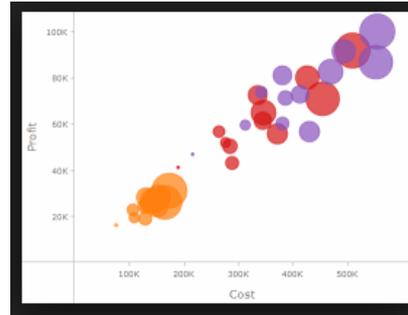
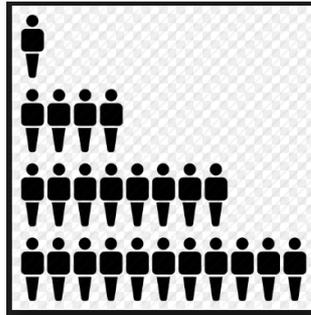
2.9%  
of State

2.9%  
D3-D4

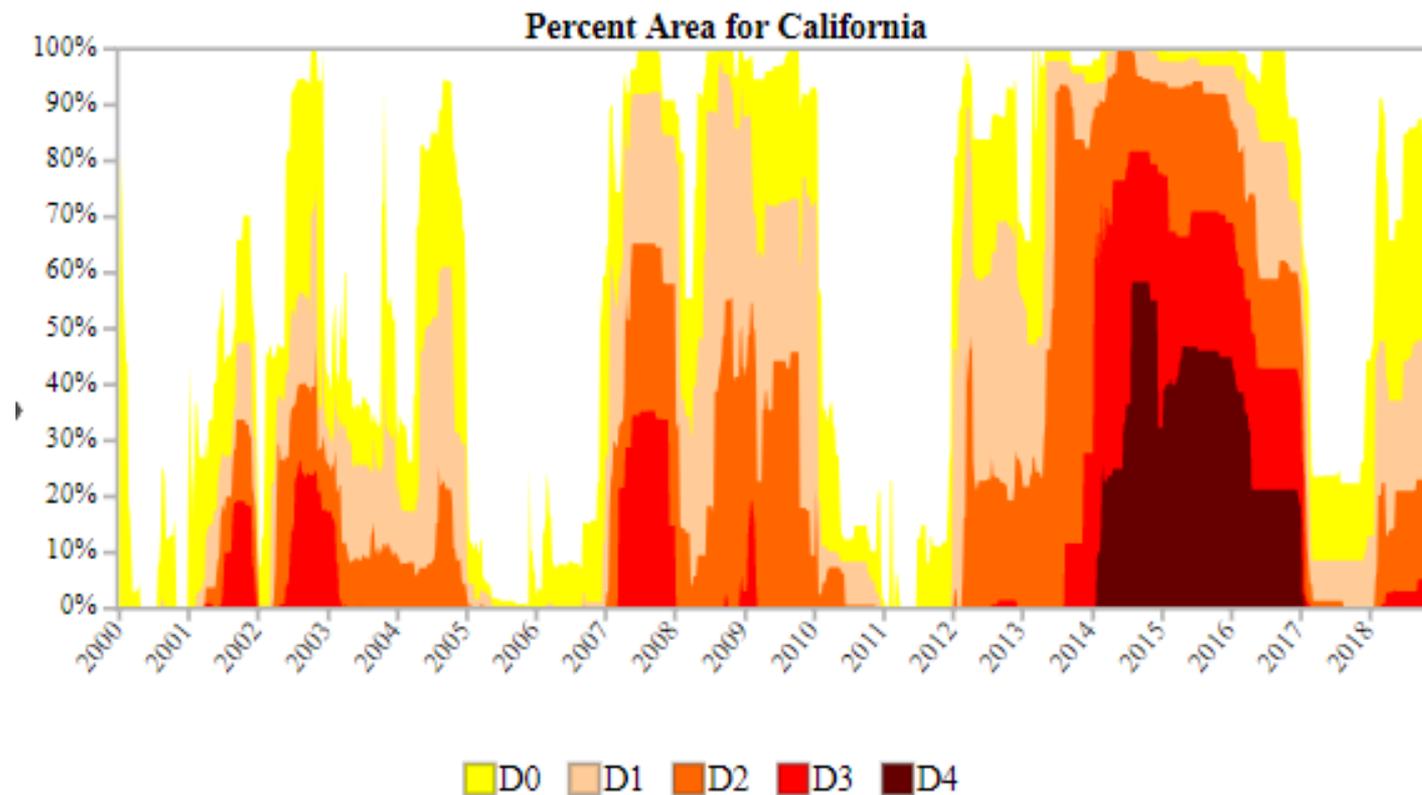


# Evolution: Presentation

- What's the narrative?
  - Just tell the users. They shouldn't have to guess, infer or figure it out.
  - This is more usable and accessible.
- 
- Not just maps!  
(but what else?)



# Evolution: Presentation

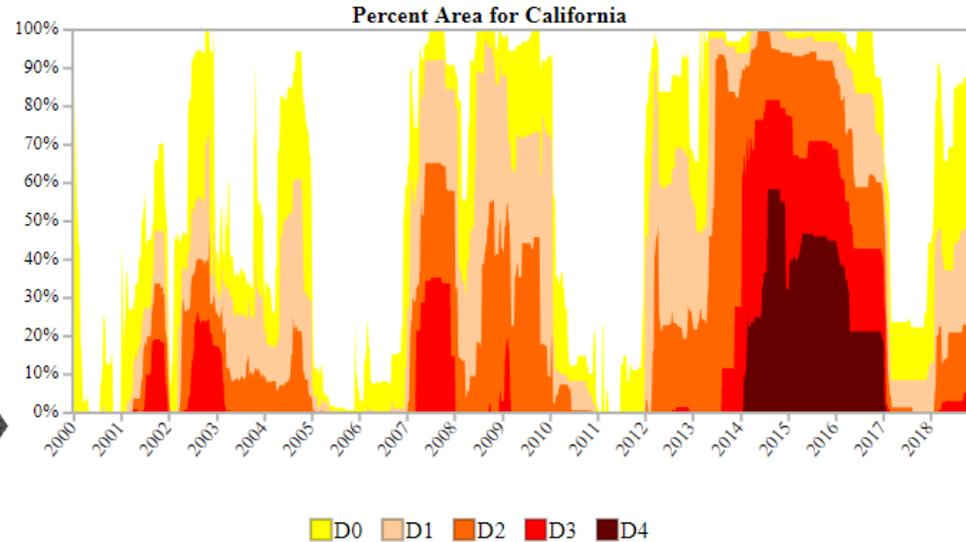


# Evolution: Presentation

## Drought in California from 2000 - 2018

The U.S. Drought Monitor started in 2000. Since 2000, California is currently experiencing the longest duration of drought (D1-D4), which as of October 16th, 2018 has lasted 356 weeks beginning on December 27, 2011. The most intense period of drought occurred the week of October 28, 2014 where D4 affected 58.41% of California land.

- Drought from 2000
- Drought from 1895



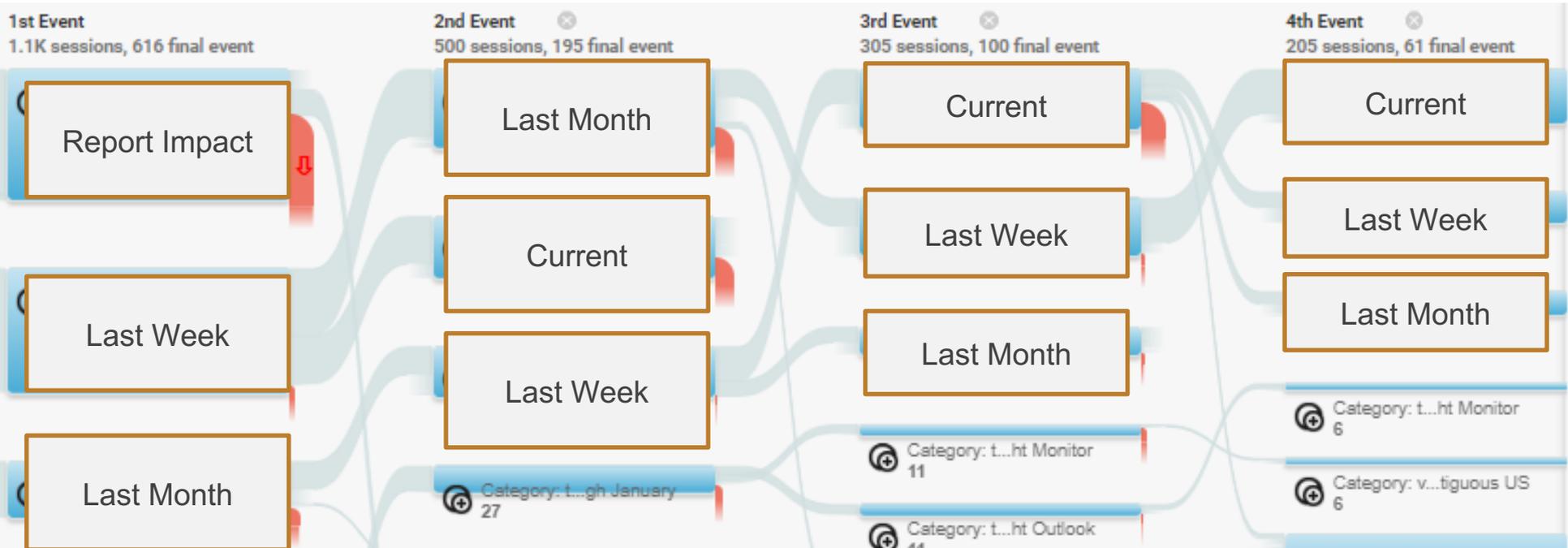
Evolution: Presentation

Analytics! - consistently monitor and learn

# Evolution: Presentation



# Evolution: Presentation



# Data Integration: North American Drought Monitor

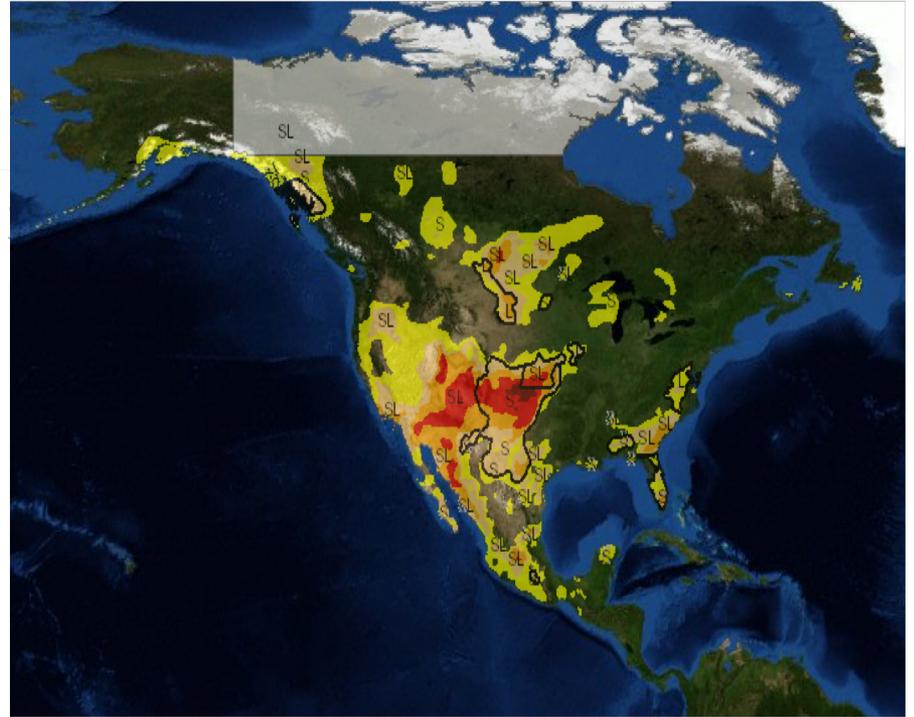
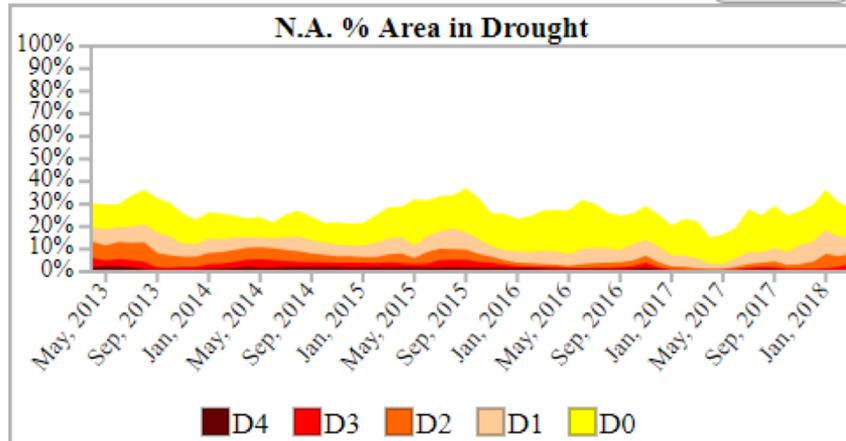
Python processing - 2 steps:

- Preprocess
  - cleans, clips, merges files
- Post-process
  - cleans, statistics, database, FTP

## Area Drought

[Download Image](#), [Download as JSON](#), [Download as XML](#)

Show Data

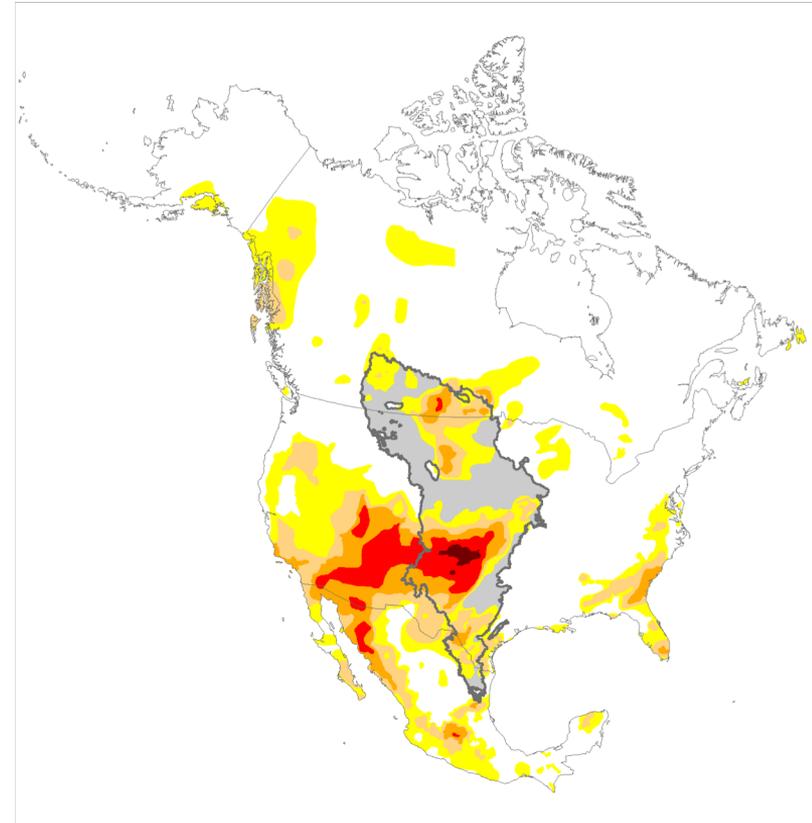


# Data Integration: North American Drought Monitor

## Shapefiles and Statistics

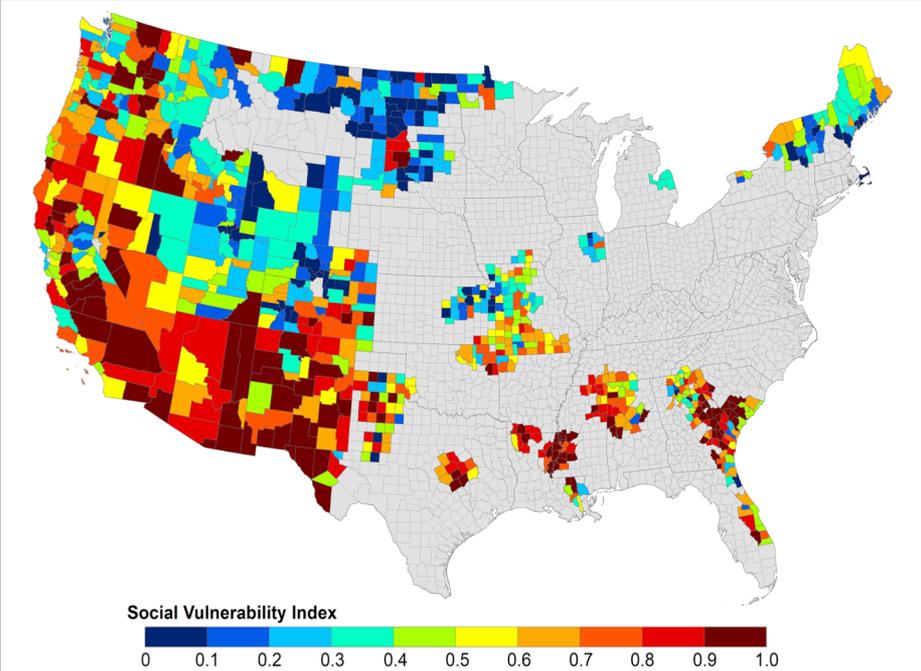
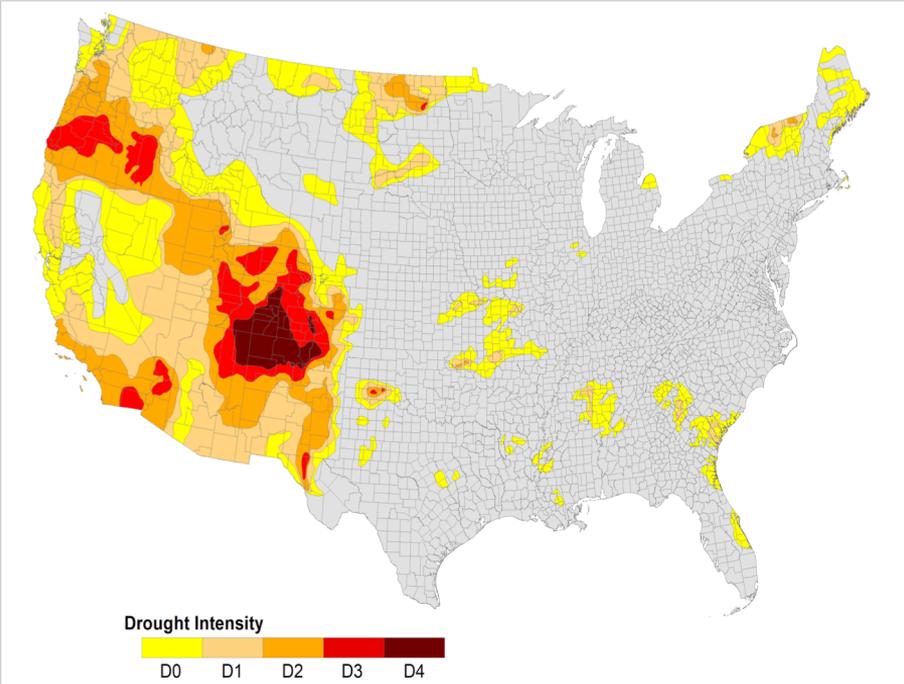
- *Columbia*
- *Great Lakes*
- *Rio Grande & Bravo*
- **Ecoregions:**
  - *South Central Semi-Arid Prairies*
  - *Tamaulipas-Texas Semi-Arid Plains*
  - *Temperate and West-Central Semi-Arid Prairies*
  - *Semi-Arid Prairies*
    - *South Central & West-Central Semi-Arid Prairies*
  - *Great Plains*
    - *Merge of all the above Ecoregions*

NADM_GreatPlains201803								
	FID	Shape	DroughtCat	Population	Pop_Pct	Year_Month	Area_SqMi	Area_Pct
▶	0	Polygon	d0	10826900	34.0505	201803	223361	21.2888
	1	Polygon	d1	4121770	12.963	201803	176263	16.7997
	2	Polygon	d2	2022430	6.36054	201803	122037	11.6315
	3	Polygon	d3	1100890	3.46228	201803	89391.9	8.52002
	4	Polygon	d4	104193	0.327688	201803	17933.7	1.70928

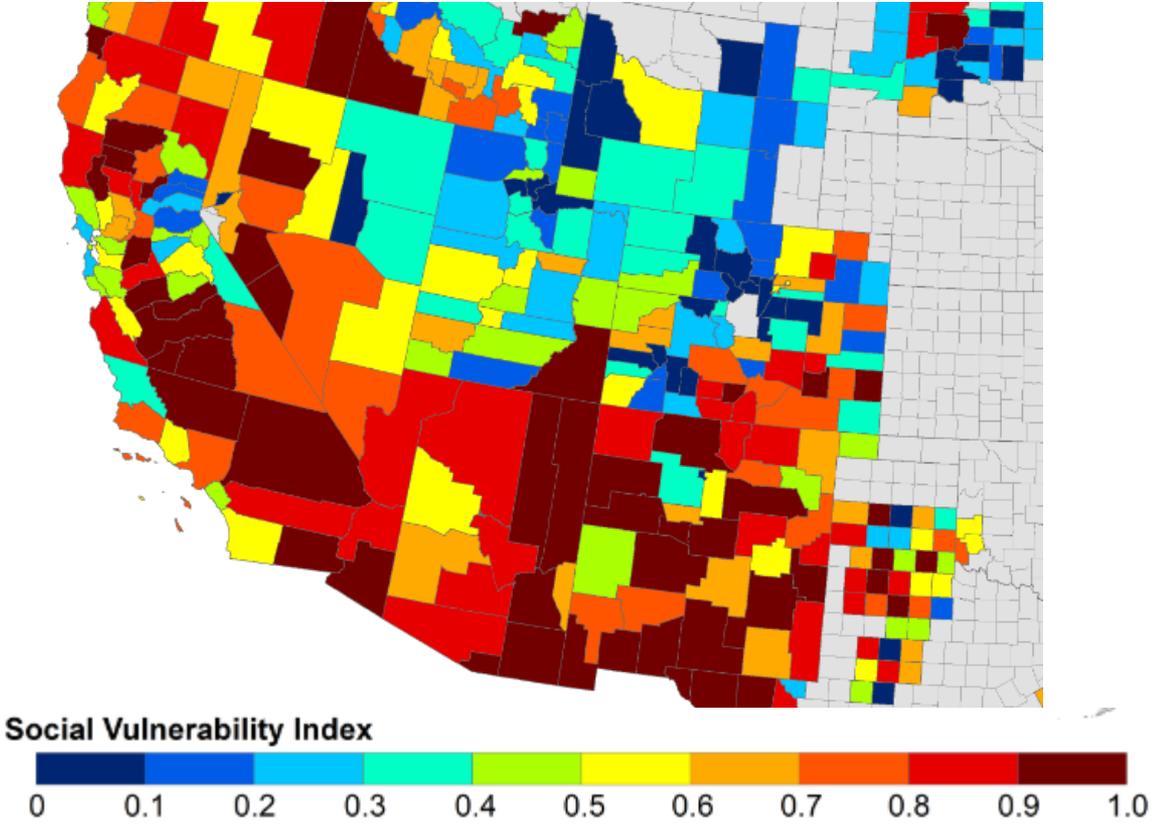


# Data Integration: Public Health

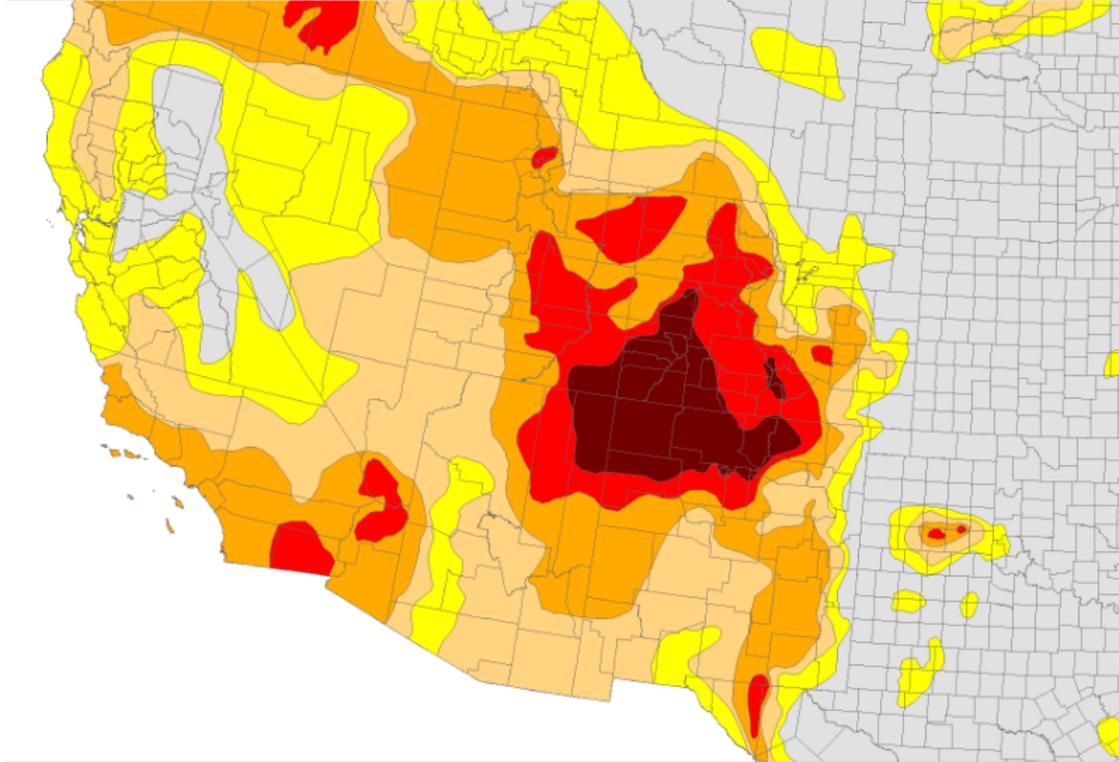
## Drought and Social Vulnerability Index



# Data Integration: Public Health



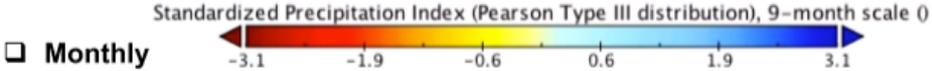
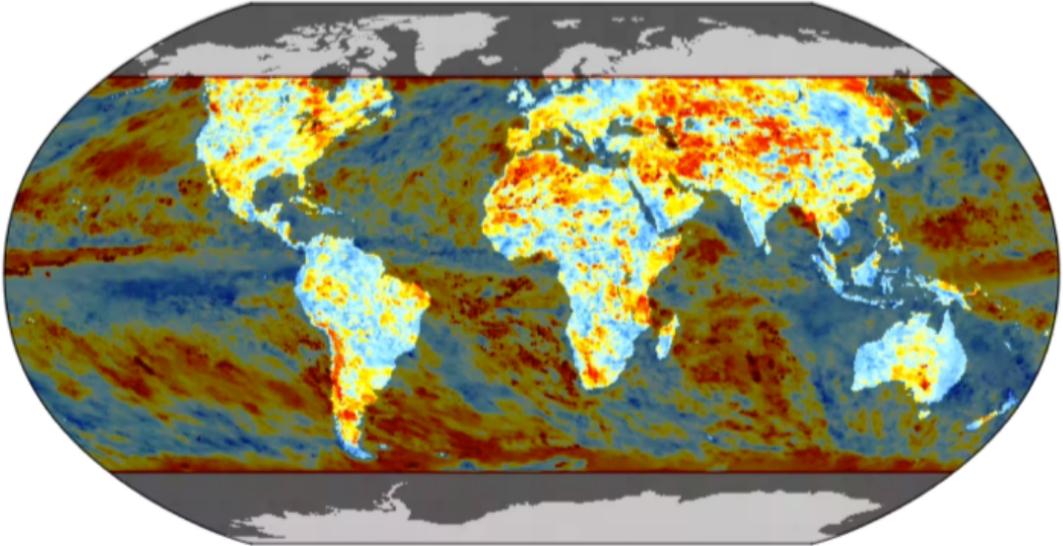
# Data Integration: Public Health



# Data Integration: Drought Indices from cMORPH

## Monthly SPI : 9-Month

Standardized Precipitation Index (Pearson Type III distribution), 9-month scale  
Time: 1999-01-01 00:00

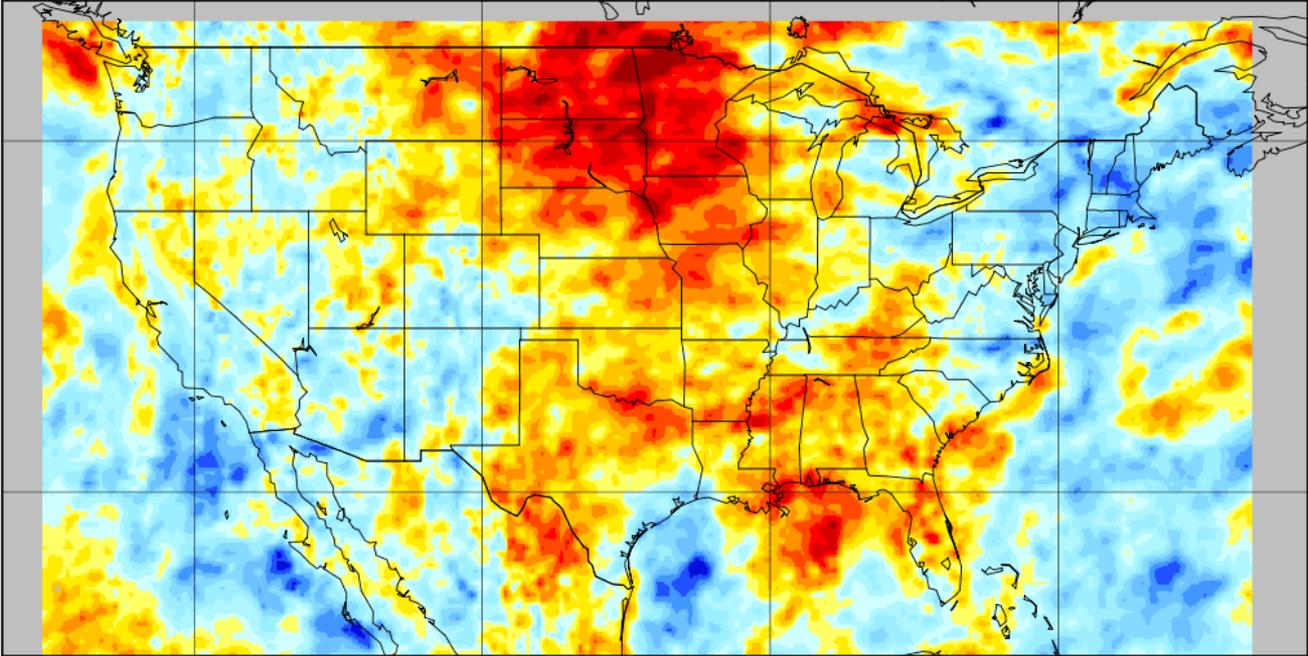


# Data Integration: Drought Indices from cMORPH

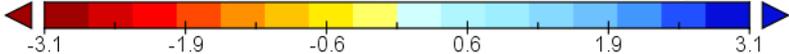
- Why?
  - Fast updates support global drought monitoring
  - Monthly and Daily precipitation totals
  - Product based on 'Gold-Standard' operational dataset at NOAA NCEI and CPC.
  - Application of Python Climate Indices to a large, gridded, global dataset.

# Data Integration: Drought Indices from cMORPH

Standardized Precipitation Index (Gamma distribution), 90-day scale

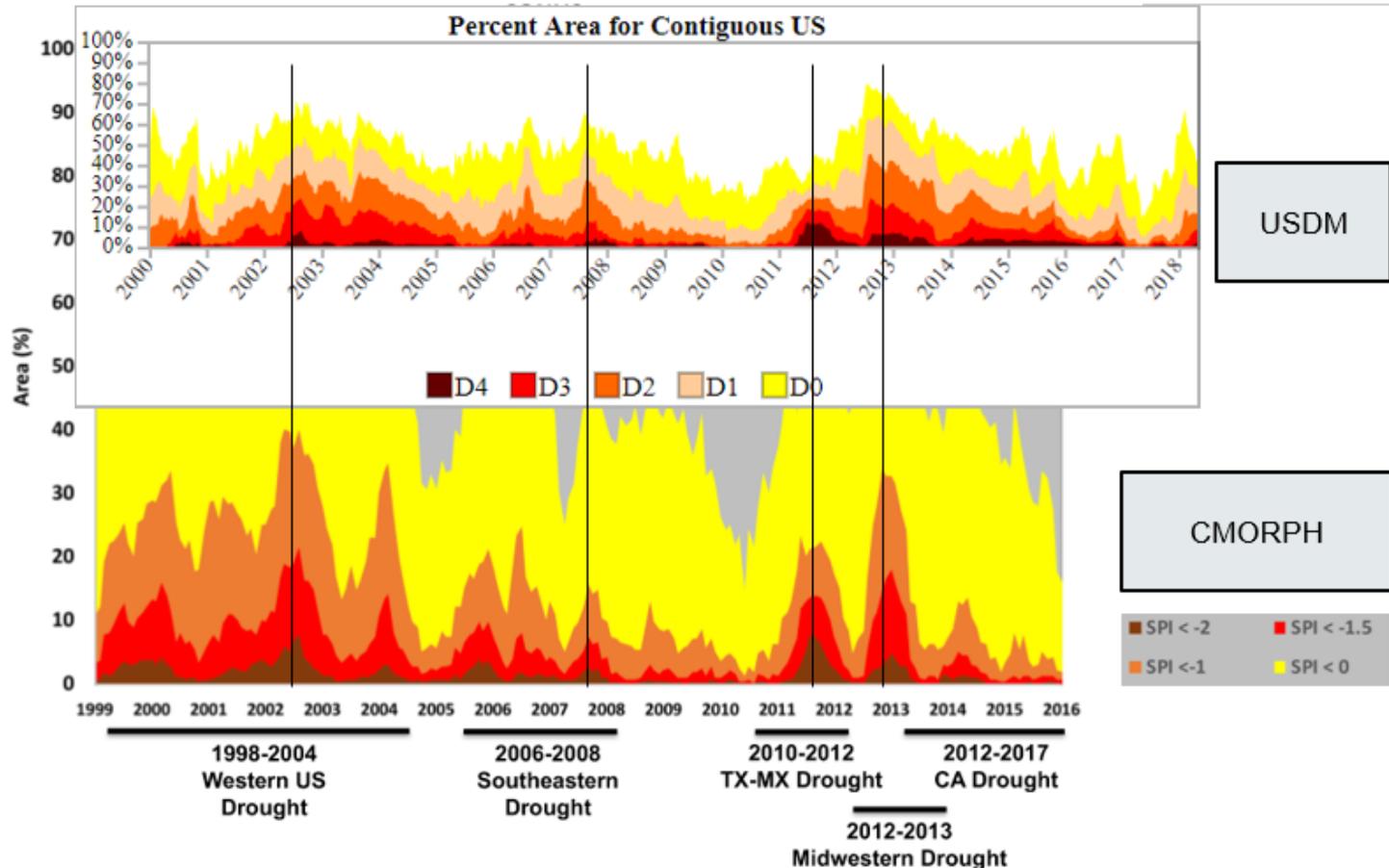


Standardized Precipitation Index (Gamma distribution), 90-day scale ()



Data Min = -3.1, Max = 3.1

# Data Integration: Drought Indices from cMORPH



# Data Integration: Drought Indices from cMORPH

## North American Drought Monitor

September 30, 2011

Released: Wednesday, October 12, 2011

<http://www.ncdc.noaa.gov/nadm.html>

**Analysts:**

Canada - Trevor Hadwen  
Richard Rieger  
Dwayne Chobanik  
Mexico - Reynaldo Pascual  
Adelina Albanil  
U.S.A. - Rich Tinker  
Richard Heim\*  
Liz Love-Brotak

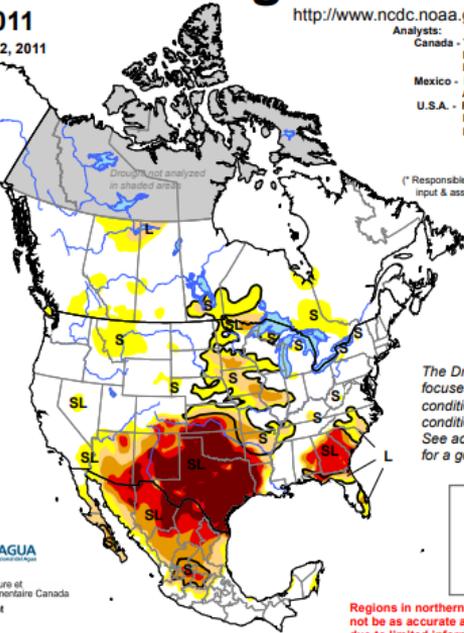
(\* Responsible for collecting analysts' input & assembling the NA-DM map)

**Intensity:**

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

**Drought Impact Types:**

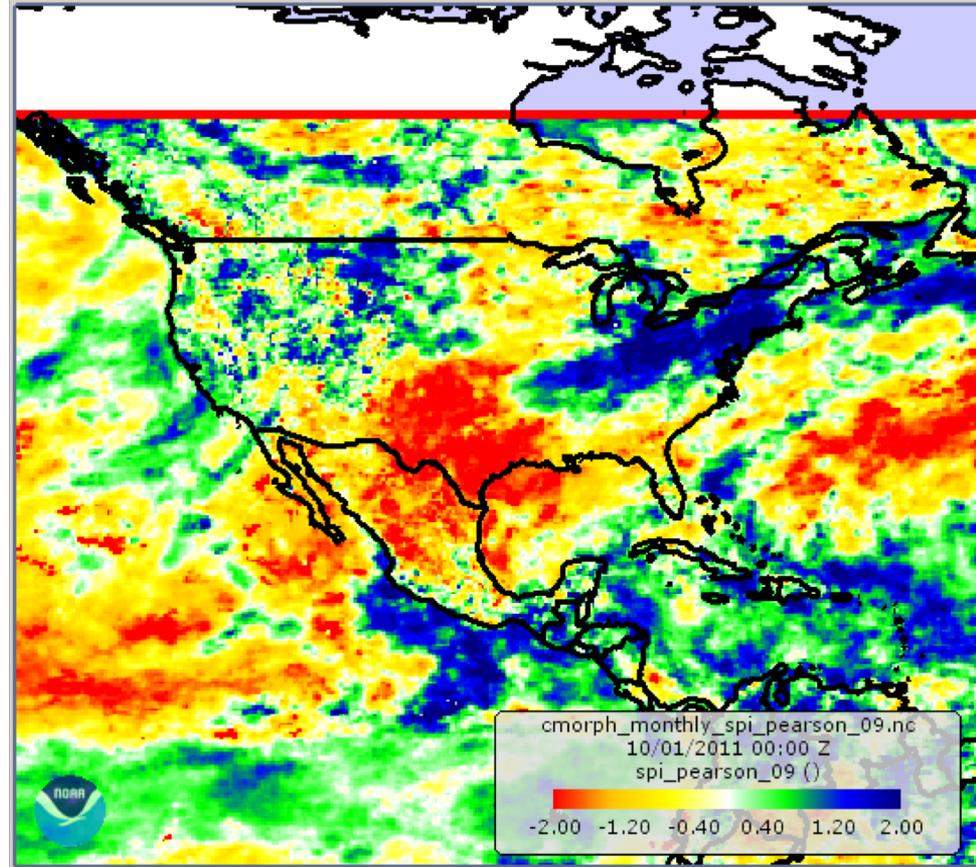
- Delineates dominant impacts
- S = Short-Term, typically <6 months  
(e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months  
(e.g. hydrology, ecology)



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text for a general summary.



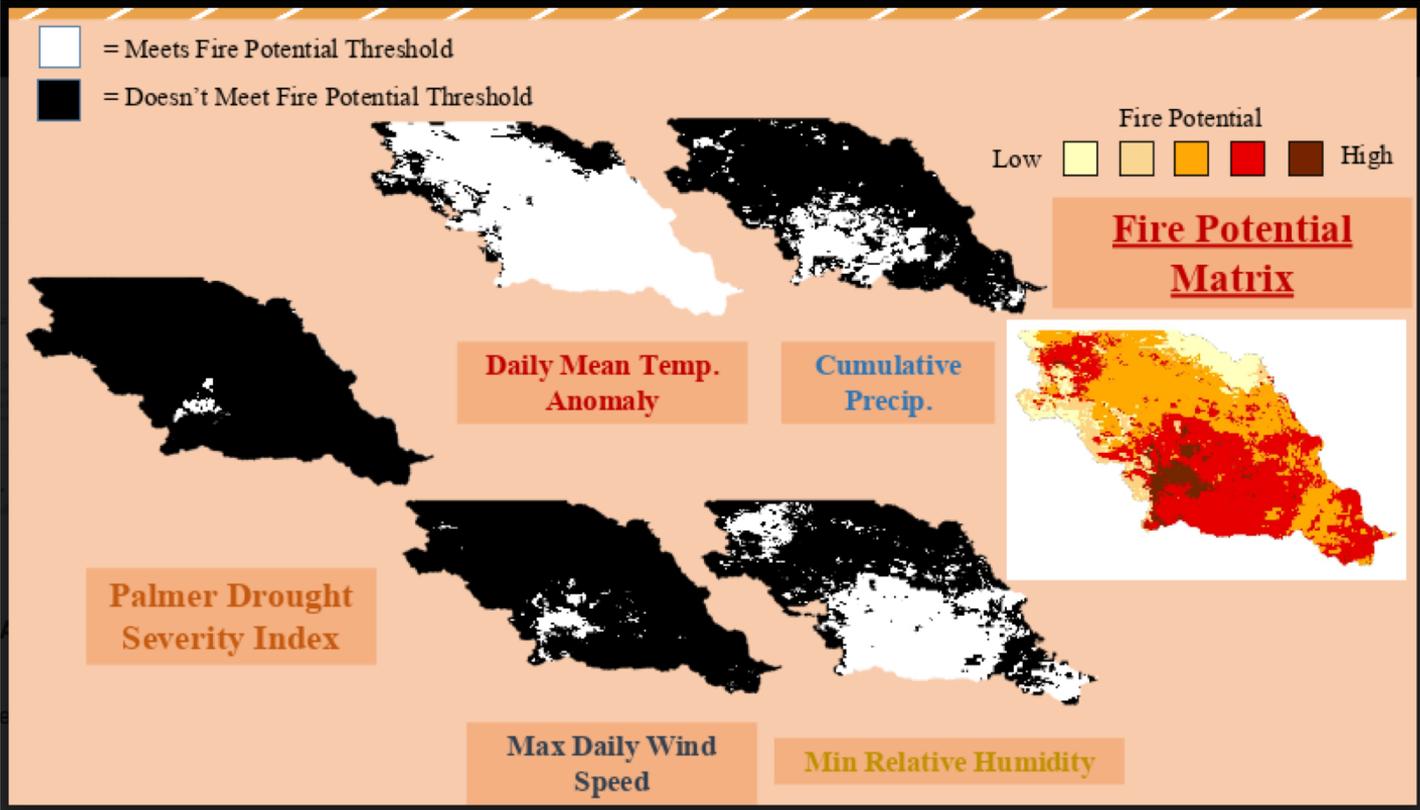
Regions in northern Canada may not be as accurate as other regions due to limited information.



cmorph\_monthly\_spi\_pearson\_09.nc  
10/01/2011 00:00 Z  
spi\_pearson\_09 ()

-2.00 -1.20 -0.40 0.40 1.20 2.00

# NASA DEVELOP support



# ArcGIS Online - StoryMap



**Drought.gov**  
U.S. Drought Portal

U.S. North America Global

Home Data, Maps & Tools Regions Research Resources What is NIDIS? News Calendar Contact Us Subscribe

## From a dry Texas autumn to exceptional drought and back

Take a deeper look into five years of a Texas disaster, and the phenomenon that busted the drought. A multi-media profile from NOAA's Modeling, Analysis, Predictions, and Projections Program, highlighting MAPP-supported drought research.



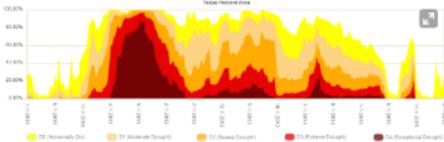
A story map   

### Evolution of the 2010-2015 Texas Drought

*LEFT: Lake Travis, Texas on September 28, 2013. The water level at full capacity should be at the tree line, but the lake was about 47 feet below its normal elevation.*

(Photo Credit: Larry D. Moore, available through a Creative Commons License)

#### 2010-2015 Texas Drought Time Series



This time series graph shows the percent area of Texas affected by each of the drought severity categories from 2010-2015. (Source: United States Drought Monitor)

# ArcGIS Online - StoryMap

## California is no stranger to dry conditions, but the drought from 2011-2017 was exceptional

How did the 2011-2017 drought fit within California's history? This story map will address this question, as well as describe the evolution of the drought, its complex causes, and implications for the future. This story map is the product of a collaboration between NOAA's Modeling, Analysis, Predictions, and Projections Program (MAPP) and NIDIS.



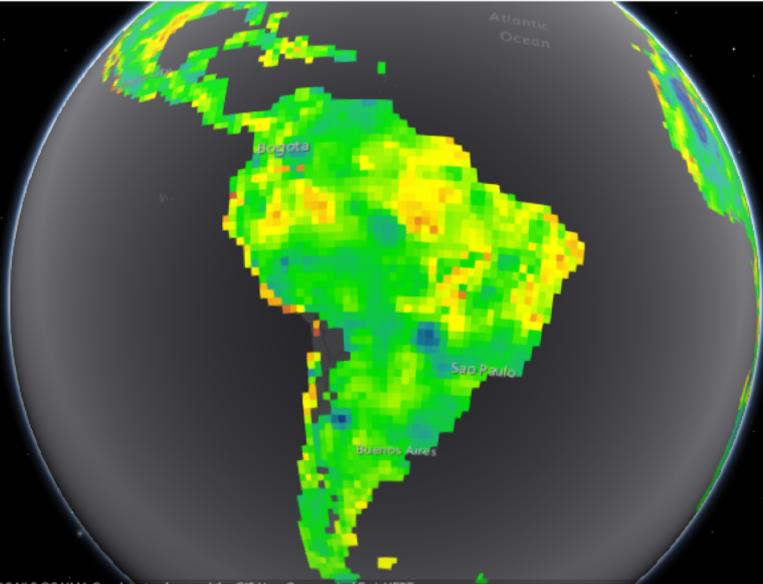
# ArcGIS Online - StoryMap

Global Drought Information System - TEST

A Story Map    

HOME Current Conditions Current Map 3D Global Map Regional Drought

Home ▾ Scene  New Scene ▾  Steve ▾



Layers Legend X 

Scene\_WTL1 

Esri, HERE, Garmin, NGA, USGS | Source: USGS, NGA, NASA, CGIAR, GEBCO, Robinson, NCEAS, NLS, OS, NMA, Geodatasystem and the GIS User Community | Esri, HERE

Powered by Esri

# ArcGIS Online - StoryMap

## Global Drought Information System - TEST

A Story Map   



HOME

Current Conditions

Current Map

3D Global Map

Regional Drought

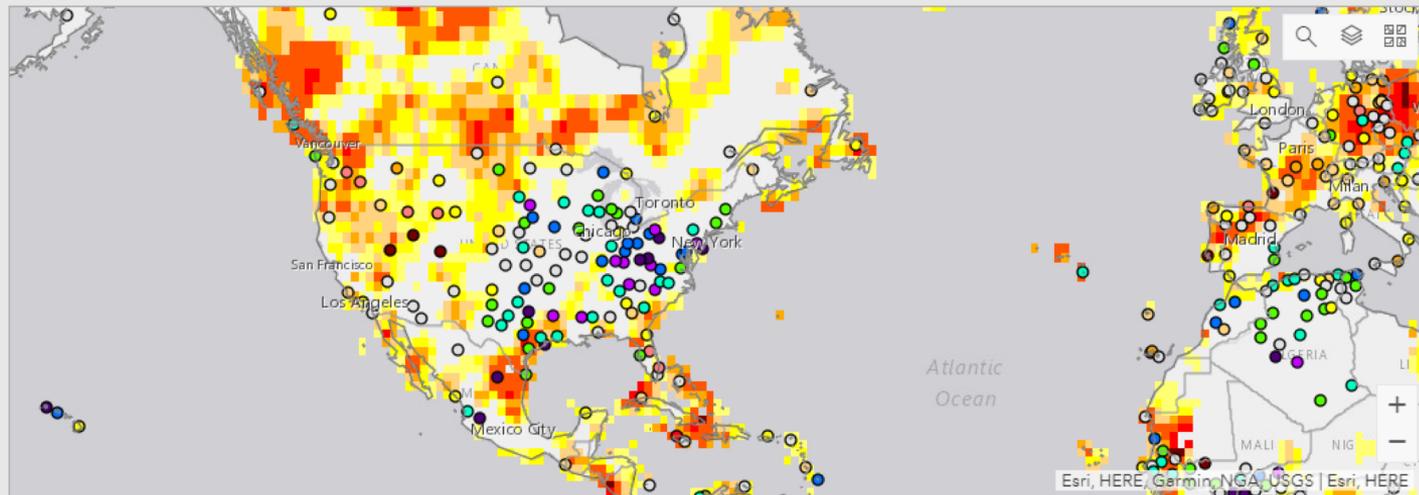
Global Drought Monitor National Integrated Drought Information System (NIDIS)



### Global Drought Monitor Data Products

The data products show the most recent current conditions for the following products:

- Station-Based SPI - generated from GHCN Monthly Data ([data](#))
- GPCC Gridded SPI - generated from GPCC Precipitation Data ([data](#))
- GPCC Drought SPI - similar to Gridded SPI product but highlights the Drought Categories ([data](#))
- [GPCC Drought Index](#) - calculated as the mean of the SPI and SPEI ([data](#))
- [Global Climate at a Glance Temperature Anomalies](#) - displays departures from a long-term average using a global 5°x5° grid ([data](#))



#### Map Legend for Drought Layers

Station-Based SPI Layers

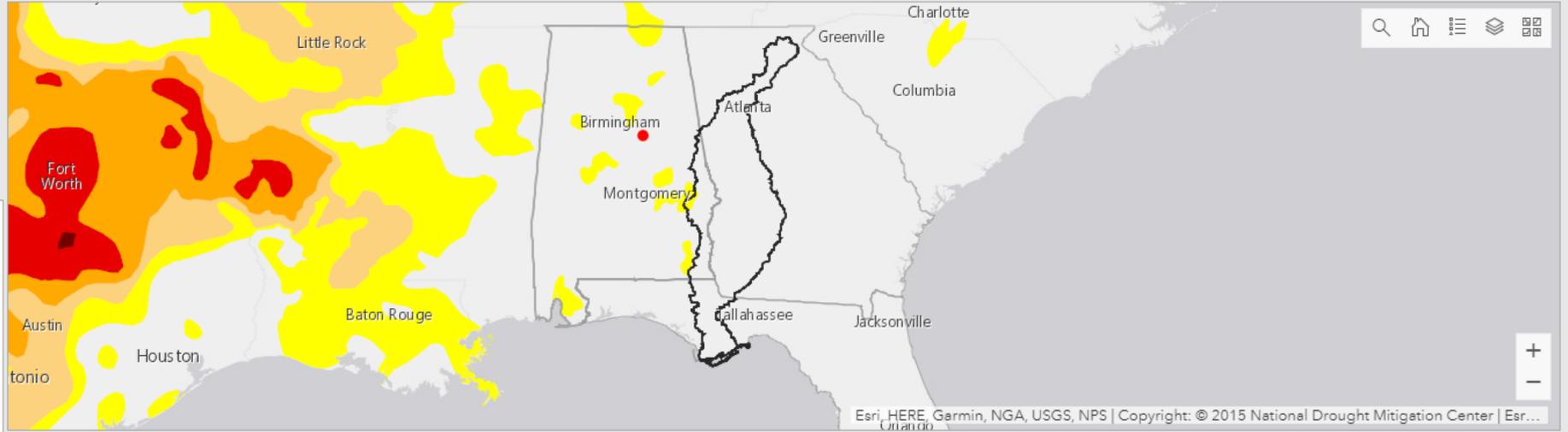
GPCC Gridded SPI Layers

GPCC Gridded Drought SPI Data

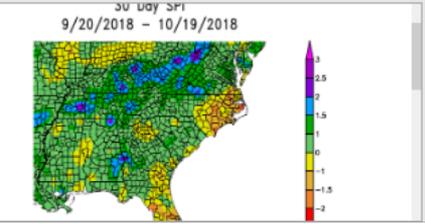
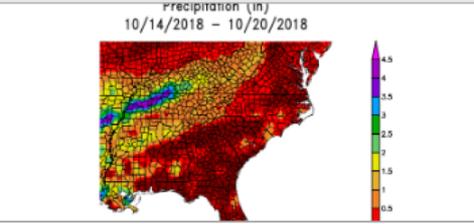
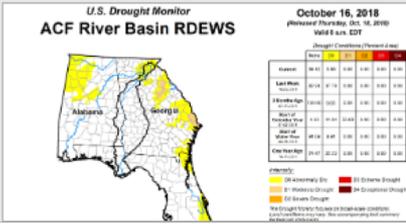
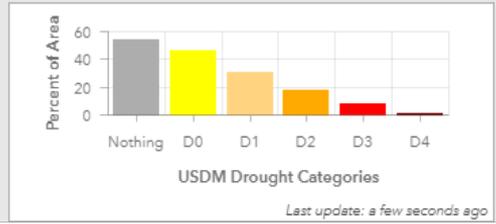
GPCC Drought Index Data

How to use this map:

# ArcGIS Online - Ops Dashboard



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# Conclusion

- Diversify, simplify, focus on portability
- Constantly evolve
- GIS is integrated in our content – NOT just a separate system or tool
- ESRI StoryMaps and OpsDashboard are compelling tools for rapid development, focused dashboards for specific stakeholders and/or prototyping
- Focus on usability, through accessibility and performance

# Thank You!

# Questions?

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Drought.gov

